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BIOTECHNOLOGY -
HARNESSING AN EXCITING NEW TOOL FOR BEEF PRODUCTION

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As ranchers and cattle breeders we are entering what may well be the most exciting decade of our era. A new tool has been unleashed. That tool is biotechnology. Yes, the future is here. All we have to do is harness this amazing breakthrough.

A 10,000 YEAR OLD SCIENCE

The idea of biotechnology is not new. For instance, over 10,000 years ago early man was making wine, beer and bread by the process of fermentation, a biological process involving one celled microorganisms. Louis Pasteur received one of our nation's first patents in the early 1800s for his process to ferment beer. So biotechnology has been around a long time and so have patents to protect biotechnological processes.

More recently you've seen many developments resulting in new and quite effective vaccines in the animal health area due to biotechnological breakthroughs. The same is true in the area of feed additives and rumen stimulants.

I intend to confine my remarks today to the applications of biotechnology in the area of animal breeding. It is that area for all of us who are animal breeders that the best is yet to come! America's ranchers are about to step into the most wonderful and marvelous decade yet known in the history of animal breeding.

The real turning point for us as cattle producers occurred at a three day meeting held at the Allerton Conference Center at the University of Illinois in April 1990. At that remarkable conference one hundred of the most distinguished scientists in the world from the field of microbiology gathered to discuss the feasibility of mapping the genome (the position of the genes on each chromosome for all our domestic farm animal species, including cattle, sheep, swine, chickens, turkeys, horses and, yes, ... fish.

Also invited was one participant from industry for each species. As Head of the Task Force on Animal Patents and Vice-Chairman of the Research and Education Committee for the National Cattlemen's Association I was fortunate enough to be invited as the cattle industry's representative.

In over forty years, I have attended literally hundreds of such conferences and seminars. Never have I attended a conference that promised such amazing possibilities as this one did. It was a revelation to say the least. As a purebred cattle breeder I realized we suddenly were about to have within our reach heretofore undreamed of opportunities.

WOMACK'S VISION

It was there at Allerton that Dr. Jim Womack, a quiet and scholarly professor from Texas A&M, laid out his vision for developing genome maps for cattle and the other major domestic farm animals. Womack is probably America's foremost researcher in this quest to locate and identify which genes are controlling which traits in the beef animal. The best and most prestigious scientists in the field were all in one location to consider the presentations of Womack and others. They came from America's finest universities as well as from universities in ten foreign countries.

A TREASURE MAP

It was quickly apparent that a map for the bovine genome as well as ones for swine, sheep and poultry were indeed feasible. Plant researchers were already years ahead of us in this area. The federal government has been expending millions of dollars in research on the plant genomes for several years. They have also earmarked \$3 billion to be spent in the next ten years to map the human genome point by point (involving possibly 3 billion base points).

There will be considerable "spin off" in technology from this human genome project for those working on plant and animal genomes. A cattle genome map of sufficient resolution to be workable could be developed within five to ten years for \$3 to \$5 million. To accomplish this, however, we cattle and livestock producers would have to "put our foot down" collectively and demand that Congress and the USDA start funding research for the animal genomes in a fashion comparable to what they were already doing for plant researchers.

THE REAL TREASURE

As important as all these developments were, I thought they paled in comparison to the theory that Dr. Morris Soller from Israel presented in his paper the second day. In one fell stroke I could see how a rancher could take his basic theory and use it to accomplish countless major goals. His theory which he called Marker Assisted Selection (MAS) lets each breeder (or for that matter breed) maintain its own individual breed goals. It allows the survival of large and small purebred operations. We could continue to use natural selection without having to employ transgenic animals. We could produce a more uniform beef product for the consumer (perhaps from animals of even more diverse genetic makeup). Most important of all, we could continue to maintain a national cow herd with a broad and diverse genetic base.

I'm not sure Dr. Soller realized the implications of all that his theories offered, but believe me, as a producer I certainly did.

The bovine map is a key part of the basic research we need to develop this principle of Marker Assisted Selection (MAS). Dr. Soller set out his MAS theory as a breeding tool during the Allerton Conference so simply and so eloquently that even a novice like myself could see the light. What a revelation this great elder scholar presented! For those of us there who were looking for practical applications and real economic benefits this kindly gentleman stole the

show.

Once we can find the markers for specific genes controlling economically important traits, we can breed genotype to genotype. But first, we've got to have the map. There is little doubt in the meantime while this basic mapping research is going on we will find some of these markers. The human mapping and research already underway is going to find a great number of these markers for us.

Now to the really bright side of the picture. It now looks a year and a half after that conference like we'll have our physical map of the bovine genome not in five years but by the end of next year. There will still be a great number of genes to find, but we'll have those first critical 150 markers with at least three markers scattered along each of the 30 chromosome pairs found in all cattle breeds. New technology is coming from the human side with robot laboratories and high speed computers with amazing rapidity. Computer programs have already been developed that are mapping as many as sixteen markers in one nine second run!

As I see it, Soller's theory of Marker Assisted Selection will become our Ultimate Quest. It can become the rancher's greatest breeding tool. The day will arrive when we can bleed all our heifers and the top end of our bulls at any time from birth to a year of age and send their blood to a lab for analysis. We'll get back a breakdown of each animal's genetic makeup showing which of the significant genes he carries in seven or eight economically important traits. You can make your selections accordingly. Some purebred breeders will be doing this for a few traits on their top bulls before the end of the year.

THE RACE IS ON!

Using this theory of MAS, for instance, Dr. Roy Ax, the recently appointed head of Animal Science at the University of Arizona, has found genetic markers for probes that can probe three different DNA sites in cattle. These probes or gene markers allow the scientists to see exactly what combination of genes are present in the animal for these three different gene pairs which have a significant effect on milk production.

When the correct pairs of genes are present at each of these three sites annual milk production in Holstein cows increases over 1200 pounds! Imagine the ramifications this can have as we breed out beef cows for exactly the right combination of genes to let a producer select for the correct amount of milk he needs for his conditions? Notice, I didn't say "select for the maximum amount of milk possible." Hopefully, IRM (Integrated Resource Management) and other educational systems have taught us that maximum production seldom means maximum profits.

This new principle utilizing this marvelous technology makes our business more profitable. Dr. Ax presented his paper this past May in San Antonio at the annual meeting of the Beef Improvement Federation. Following his presentation were equally brilliant papers by Jerry Taylor from Texas A&M on mapping the bovine genome and by Dr. Noelle Muggli-Cockett from Utah on genetic marker probes that she's developing for disease resistance.

TRANSGENICS

Let me spend a moment now on another form of biotechnology -- transgenics. First, we need to define a transgenic. It is an animal whose DNA has been genetically engineered or altered from that which it could have received by natural selection from its parents. In other words, a new gene has been added or substituted to what could have been this animal's natural occurring DNA makeup.

Those whom I believe to be very knowledgeable in this field tell me that transgenics as such are still a long way off (perhaps ten to fifteen years) in terms of viable and useful transgenic sires. They'll have tremendous costs. The first bulls could run as high as ten million dollars and have only one or two "tagged" gene alterations.

Transgenics inspire the most romance and conversation in this area of biotech development (and perhaps the most controversy). I have attended a lot of conferences, seminars and meetings on transgenics. As I have said before, I'm certainly not an expert in the technical area of this field, but I certainly have developed some expertise in the legal side of transgenics. We have striven for the last four years now to work to protect farmers and ranchers from some of the practical implications of our current patent law as it bears on each and every one of us when and if transgenics become a practical reality.

One thing that worries me greatly about transgenics is that they presently have a very bad perception with the public at present both here and in Europe. Significant percentages of the public perceive genetic engineering as being either environmentally unsound or morally and ethically wrong. Still others attack it on religious grounds. My concern is that if two dairy states like Minnesota and Wisconsin can react to BST as they have, what will happen when transgenics arrive -- assuming they do. Scientists in Switzerland, Germany and some of the Scandinavian countries will tell you that the so called "Greenies" have already shut down considerable of the transgenic research in their countries.

The breed associations are also going to have some real problems when transgenics arrive. I continually counsel them to get started now setting up panels and committees to decide what, if any, transgenics they will permit. Is an animal that's purebred in every way but carries a new gene making it resistant to pink eye or mastitis or bangs going to be allowed? How about a Hereford with a Holstein gene for milk? Is it will a Hereford? How about a Santa Gertrudis with an Angus gene for marbling?

A TWO HUNDRED YEAR OLD PATENT LAW

Perhaps more importantly to all of us, a transgenic beef animal under current law is patentable. The offspring of any transgenic animal containing the specifically engineered gene might very well also be patentable under our present law which Thomas Jefferson drew up in 1790.

Once the possibility of transgenic mammals was a reality, and in April, 1988 when the

U.S. Patent Office began issuing patents on such genetically engineered animals, the NCA stepped to the forefront to try and develop practical federal legislation in this area of animal patents. Our goal was to try to draft an exemption for farmers and ranchers from current patent law that would be both fair to the inventors and also to the industry if it tried to implement and utilize these transgenics in our food chain.

We currently have a resolution in our NCA Policy Book which states that the beef industry supports the principle of patenting the techniques and the processes of genetic engineering and accepts the techniques and the process of genetic engineering and accepts the Supreme Court ruling allowing the patenting of transgenic animals but it does not support the application of current patenting laws and royalty payments to the future offspring of patented transgenic animals.

Several major questions that arise under our present law remain unanswered. Who is going to keep track of which genes are in which animals? Can purebred herds afford to risk operating if any animal found to be harboring such a "tagged" gene in their herd was subject to royalties and infringement penalties anytime during a 17 years patent life? How could herds using multiple sires operate under such a threat? Finally, in view of the accidental matings that we all know can take place, how would a registered or commercial breeder protect himself from the liabilities he'd incur if a key sire in his herd turned up with a genetically engineered gene no one even knew he carried?

THE NIGHTMARE

The potential exposure to lawsuits and economic ruin for producers found to have unauthorized transgenic material in their animals, should such a discovery of "tagged" DNA material occur, simply boggles the mind. Keep in mind these genetic alterations which could be traced generation after generation are additive. In 50 years we could have cattle with dozens if not hundreds of different altered germ cells in their DNA.

The NCA feels it is imperative to develop federal legislation allowing for full patent protection on the processes and techniques used in developing transgenic farm animals. So far, however, we've been unable to get such a bill through both houses of Congress in the same session. The plant people succeeded in getting such a protection act passed in 1970.

A BRIGHT FUTURE

As I see it, Marker Assisted Selection (MAS) will be much cheaper than transgenics. It will arrive sooner. It's clean -- offering no threat to the environment. It doesn't generate negative public perceptions. We aren't adding genes from any other species to our beef product. It allows our nation to maintain a much larger gene pool for both seedstock and commercial producers. A more varied gene pool will in turn afford more producers under different climates and conditions the opportunity to make their individual selection decisions toward a more uniform product. The use of Marker Assisted Selection also allows us to avoid the undue concentration of the seedstock industry into just a few hands.

It's going to be very interesting to see which breeds and which breeders adopt these new tools for selection. As Breeding Values replaced In Herd Ratios, so then did EPDs replace Breeding Values. Now comes MAS. Learn its theory. Don't be afraid of it -- profit by it!

In the meantime, I'd urge you to seek your replacements, whatever your breed, from breeders who know and utilize the EPD and MAS tools. You stand to profit a great deal if you do.

In conclusion, I'd say, "Get ready". The most exciting chapter of animal breeding is about to be written, and you're living in the middle of it!